CORRESPONDENCE

REMARKS ON "PERSISTENCE OF EXTREMELY WET AND EXTREMELY DRY MONTHS IN THE UNITED STATES"

A. J. DRUMMOND

Weather Bureau, Pretoria, Union of South Africa
January 7, 1952

I was very interested to see the paper "Persistence of extremely wet and extremely dry months in the United States," by Messrs. C. S. Gilman and J. T. Riedel (*Monthly Weather Review*, vol. 79, No. 3, March 1951, pp. 45–49). The extension to the United States network of rainfall stations of such investigations into the problem of persistency of dry and wet spells will, I am sure, be welcomed by workers in statistical climatology.

However, there are certain points in this account which are not strictly correct and I should like to divert the authors' attention to them. The paper referred to as [5] (Beer, Drummond, and Fürth, *Quarterly Journal of the Royal Meteorological Society*, vol. 72, No. 311, January 1946, pp. 74–86) is, I feel, misrepresented. The following amendments are relevant:

(a) The rainfall data discussed in that paper are not the same British data as used by Cochran (reference [4]), but were specially assembled for the former investigation. The length of record available at the seven selected stations varied between 70 and 130 years. This material represented five distinctly different rainfall regimes (annual rainfall 610–3,440 mm.) and certainly the most homogeneous long-period rainfall records existing for the British Isles. It was considered that the treatment had to be confined to such measurements if reliable results were to be expected.

(b) Table 2 in Gilman and Riedel's paper purports to refer to the British Isles generally, but this is not so. The values quoted, establishing the absence of correlation between the amounts of rainfall in successive months, are those for only one of the stations, viz. Kew Observatory (1856–1944). This is however of minor importance as broadly similar results apply to the other six stations.

(c) The statement which appears in the last paragraph of section 2 (p. 46, col. 2) of Gilman and Riedel's paper, "Summarizing: In England there seems to be a tendency towards persistence for wet and dry months, the tendency being slightly stronger for dry," is at variance with the conclusions arrived at in the Beer, Drummond, and Fürth paper. Now, the latter work clearly established that a close relationship existed between m, the number of successive like months, and F, the frequency with which such a series occurred; namely $\log F = Rm + S$, where R and S are constants for each station. After a statistical examination for the absence of correlation (standard χ^2 test for independence), a mathematical theory was advanced on the basis that the sequences were purely accidental. The probability formulae obtained explained fully the empirical relationship, giving a satisfactory representation of the observational data. This result is evident in the following extract from table II of the original paper.

Frequencies per 100 years of specified runs of wet and dry months at certain stations in the British Isles

General averages (5 stations: annual rainfall 770–3,440 mm.)

Runs of at least (months)	Wet months		Dry months	
	Observed	Calculated	Observed	Calculated
1	301	292	303	292
2	131	134	157	158
3	60	61	87	86
4	27	28	43	46
5	12	12	24	25
6	5.8	5.9	13	14
7	1.3	2.7	6.0	7.4
8	.8	1.2	2.9	4.0
9	.5	.6	1.9	2.2
10	.2	.3	1.0	1.2
11	.2	.1	.4	.6
12	0	0	.2	.3

At the same time it was pointed out that the degree of divergence between the corresponding wet and dry lines (i. e. plots of $\log F$ against m) exhibited in some way the meteorological character of the particular station. Since the size of this angle depends upon the ratio p/q (where p and q = the proportion of dry and wet months respectively in the total), it expresses the amount of asymmetry of the rainfall frequency curve. This significant relationship appears to be a rather complex one, as was brought out by trial plots of the ratios against various rainfall constants.

Finally, it was emphasized that the independence of consecutive rainfall figures is obviously due to the length of the period examined (i. e. 1 month in this instance) and that a statistical "after effect" will come into play for sufficiently short periods. In this latter case the statistical distribution would be different from that observed above and a similar "stirring up" of the order of events would alter the frequencies instead of leaving them unchanged. The investigation of such shorter periods should lead to results of considerable practical

importance to meteorologists in so far as determining the length of period within which consecutive events of "wetness" and "dryness" affect each other.

REPLY

C. S. GILMAN AND J. T. RIEDEL
U. S. Weather Bureau, Washington 25, D. C.
January 25, 1952

Mr. Drummond is quite right in pointing out that the data analyzed by Beer, Drummond, and Fürth are not the same as those analyzed by Cochran and that the data in our table 2 refer specifically to Kew rather than generally to the British Isles. With regard to the conclusions regarding persistence in England, we feel that although the χ^2-value in our table 2 (Beer, Drummond and Fürth data) is not significant, the results of earlier investigators do show significance. Specifically Cochran's data, as shown in our table 1, give a significant value of χ^2. In view of the known insensitivity of the χ^2-test to type II error we feel that more weight should be given to the results of tests that do show significance. Presumably the chance explanation given in part 3 of the paper by Beer, Drummond, and Fürth would not have been applied to data with significant χ^2-values.